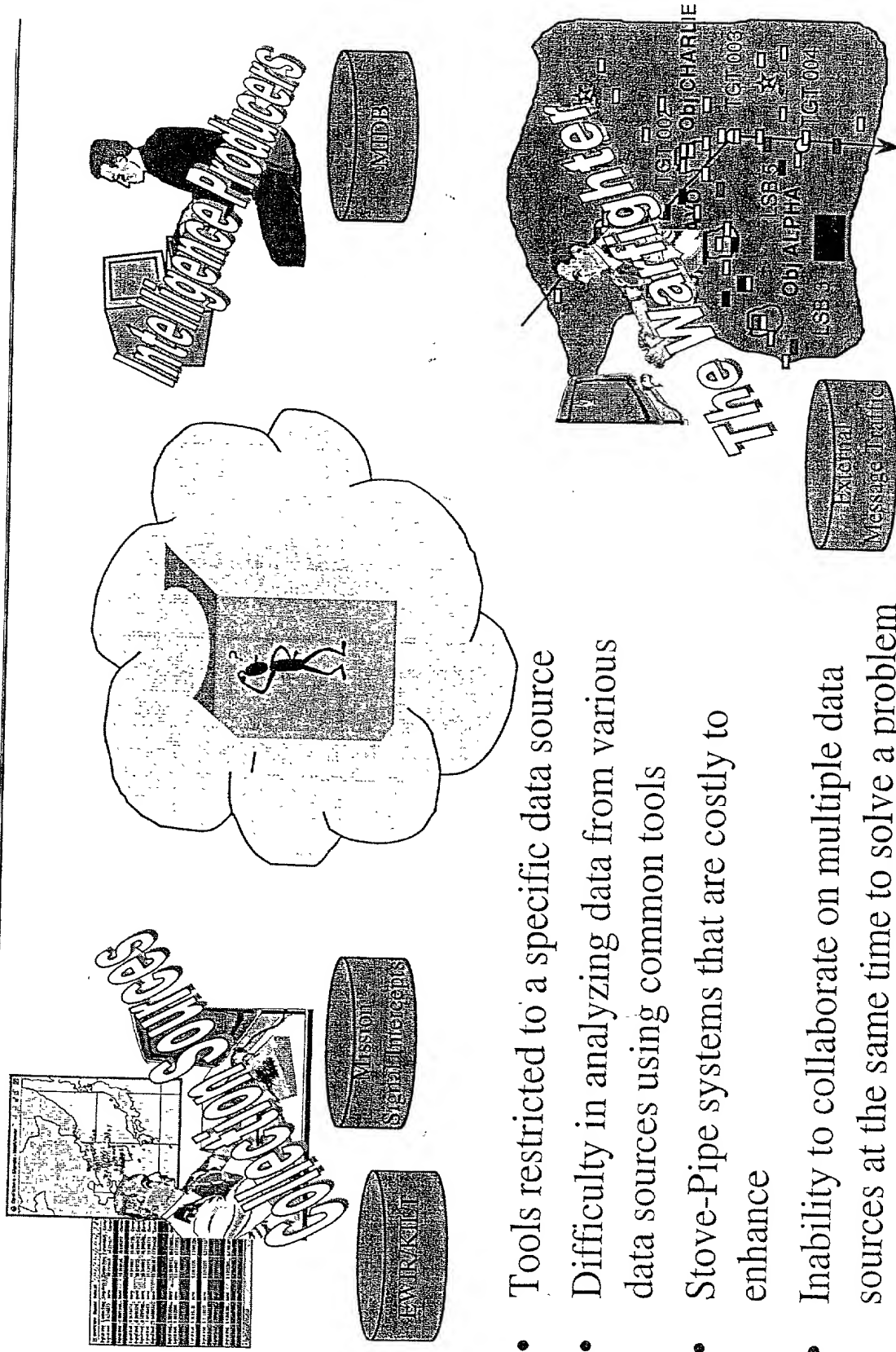


TODAY



- Tools restricted to a specific data source
- Difficulty in analyzing data from various data sources using common tools
- Stove-Pipe systems that are costly to enhance
- Inability to collaborate on multiple data sources at the same time to solve a problem

Collaborative Interoperable Environment

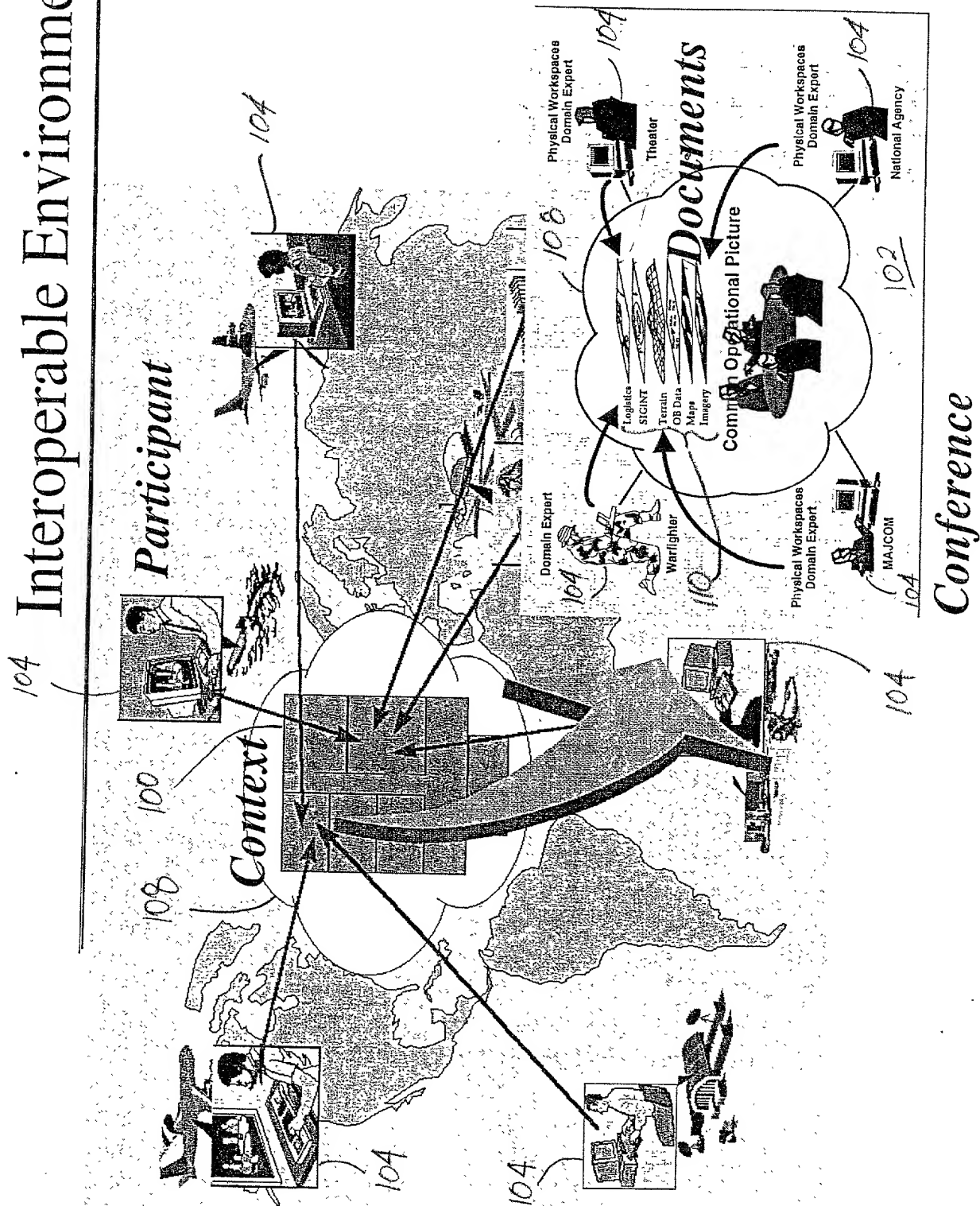
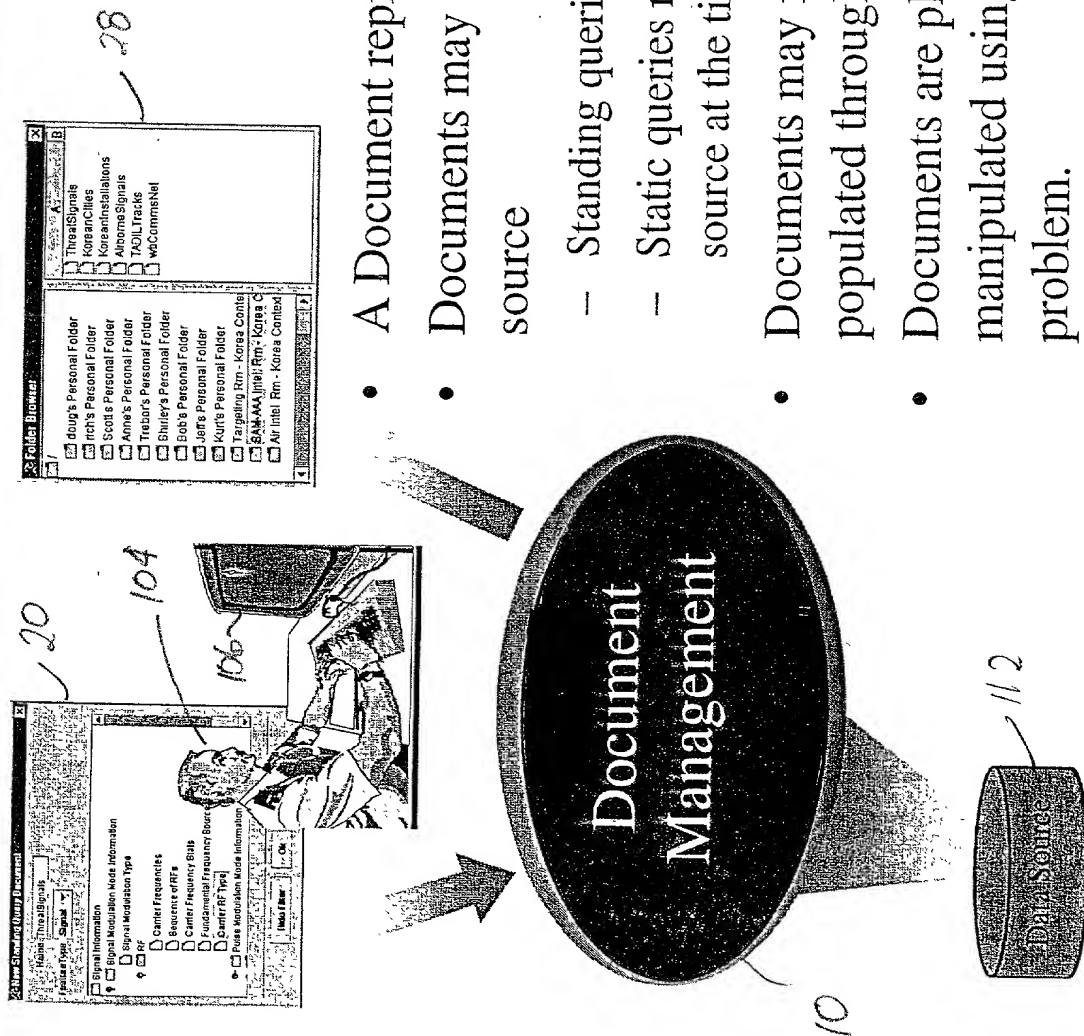


Fig 2

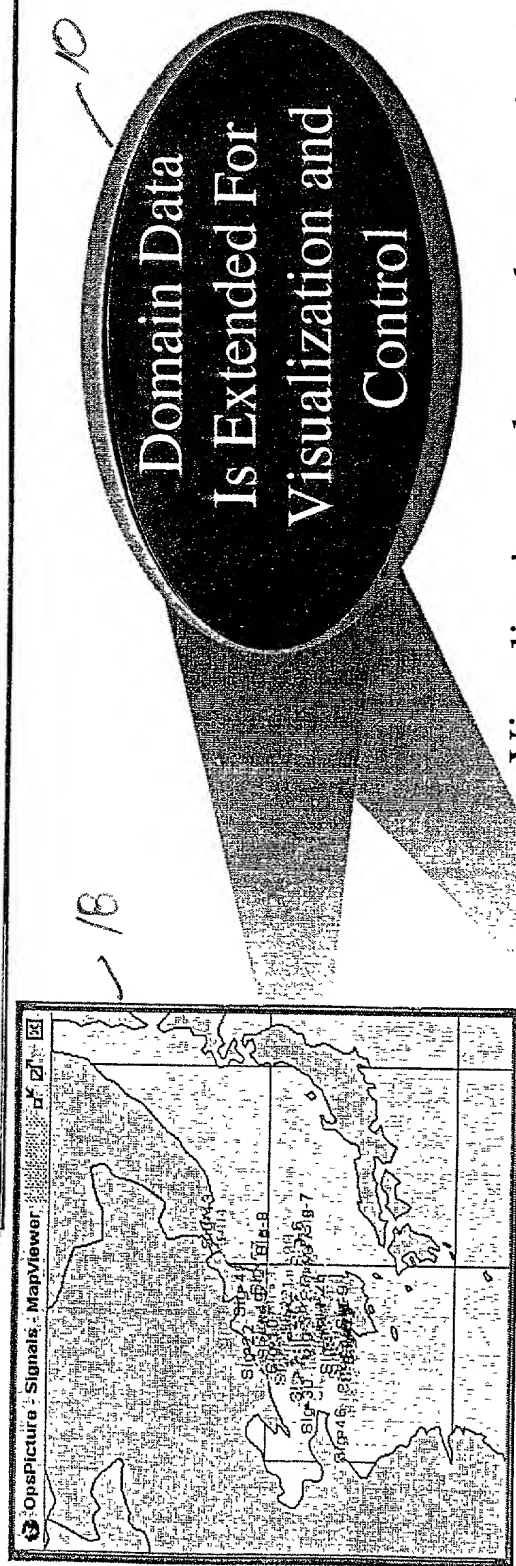
“Document” based data manipulation



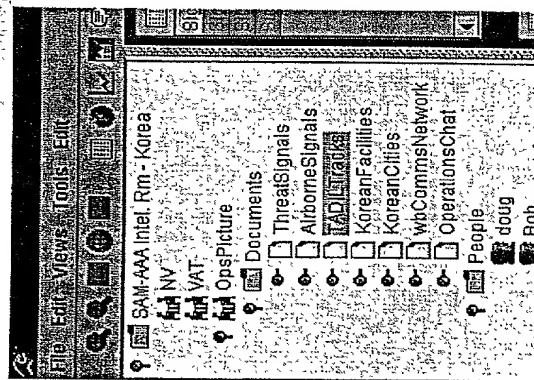
- A Document represents a collection of data
- Documents may be created by querying a data source
 - Standing queries are constantly evaluated
 - Static queries represent the state of the data source at the time the query was initiated
- Documents may initially be empty and populated through user or agent actions
- Documents are placed in conferences to be manipulated using the tools that best solve the problem.

Fig 3

Thin Clients interact with data represented by a document



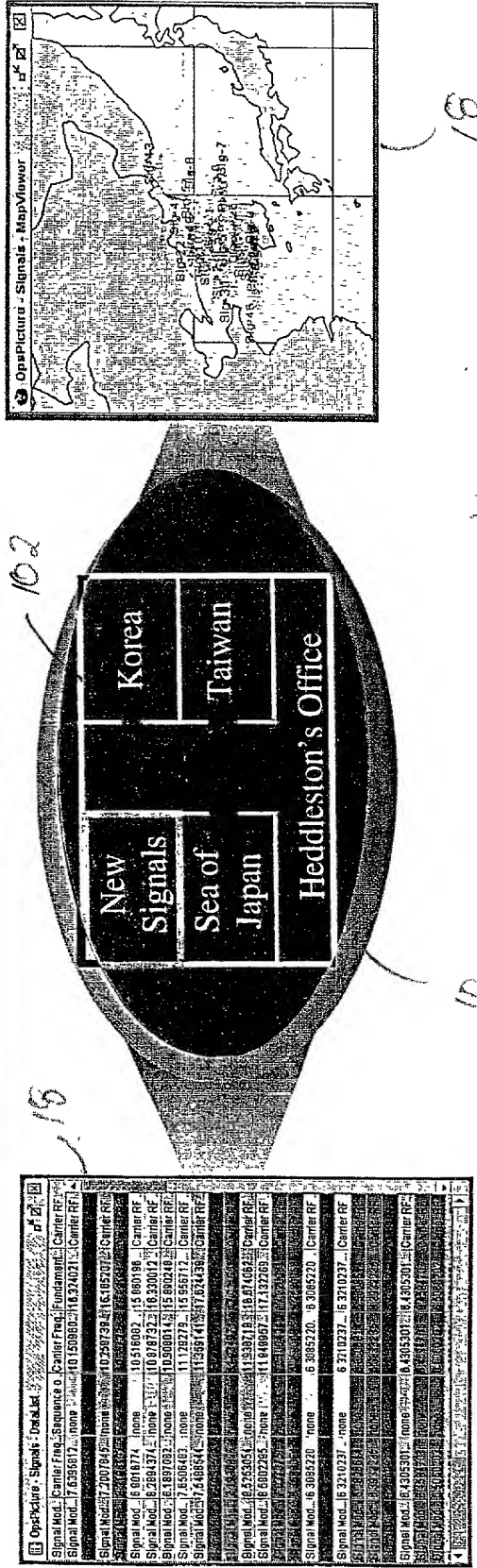
- Visualization and control properties (e.g., color, selection, symbol, etc.) become part of the data
- Client viewers focus on presentation of information
- Clients do not require logic dealing with collaboration
- Clients do not require complex logic to access data



Displaying documents using various tools

Fig 4

Collaboration on Multiple Views

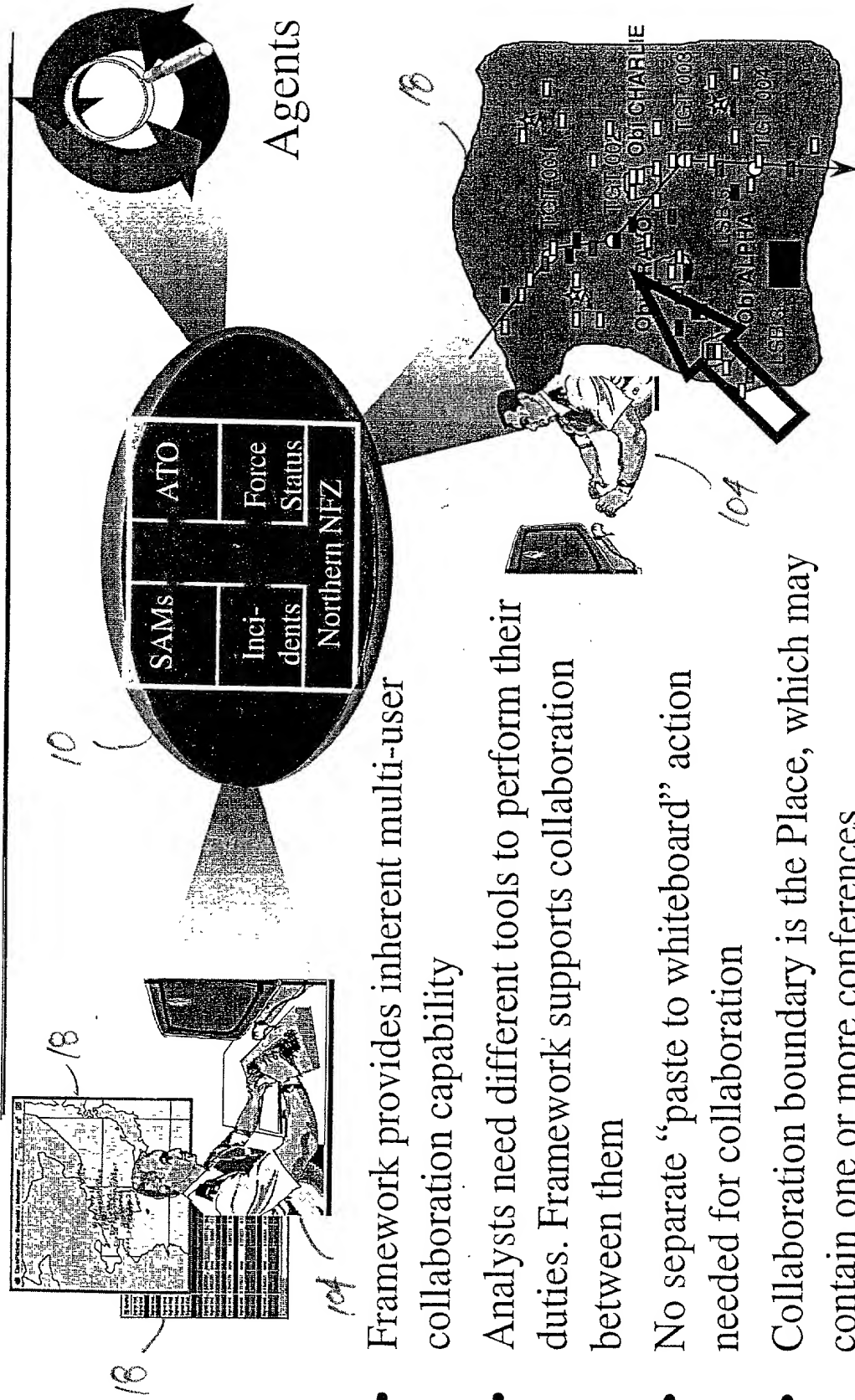


- Single user collaboration
- Multiple tools in the same conference coordinate visualization (e.g. highlight, color)
- All tools in a conference cooperate for problem solving
- No tool-to-tool communication



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Flexibility and Collaboration



- Framework provides inherent multi-user collaboration capability
- Analysts need different tools to perform their duties. Framework supports collaboration between them
- No separate “paste to whiteboard” action needed for collaboration
- Collaboration boundary is the Place, which may contain one or more conferences
- Collaborators may be agents as well as humans

Fig 6

Architectural Strategy

Key Reference Architectures

- **Object Management Architecture (OMA)**
 - OpenGIS, CosServices
- **COE Layered Architecture**
- **UCA Cryptologic Framework**
- **USIGS**
 - GIAS

Key Data Models

- SOM, MIDB, JCDB, ASAS, L245, ECDS,
TEXTA

Architectural Patterns

- **Layered Architecture**
- **Data Centric Architecture**
 - **Information Management Framework**
 - **Interactive Analysis Framework**
- **Mission Management Architecture**
 - **Task Management Framework**
 - **Resource Management Framework**

COTS SW Infrastructure

- **JAVA/C++**
- **CORBA**
- **Enterprise Java Beans**
- **RDBMS/ODBMS**
- **Microsoft Windows**
- **WEB Server/Browser**
- **XML / DOM**

COTS HW

- **UNIX SMP Server**
- **NT Workstations**

Services Based Architecture

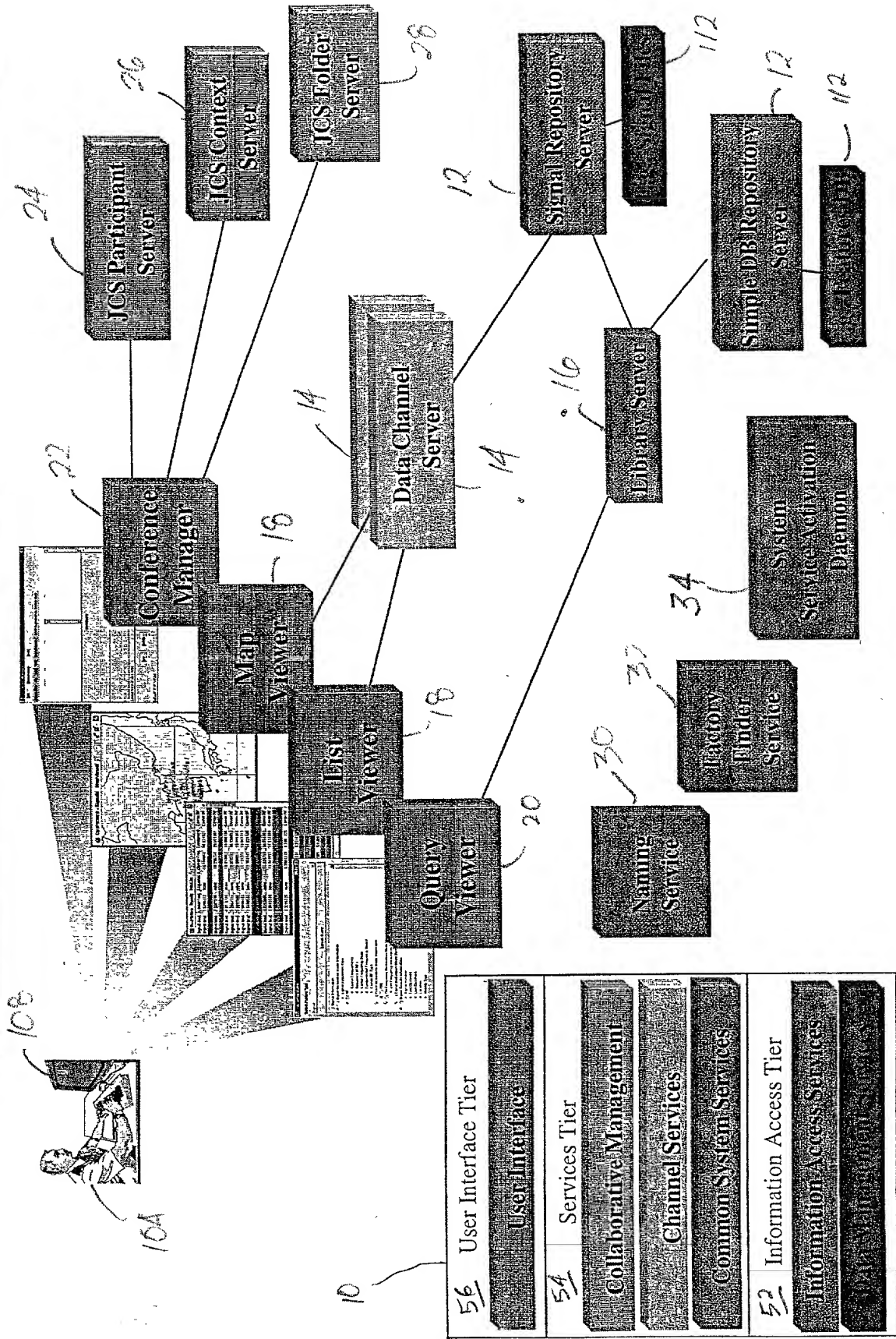


Fig. 9

Extending The Infrastructure

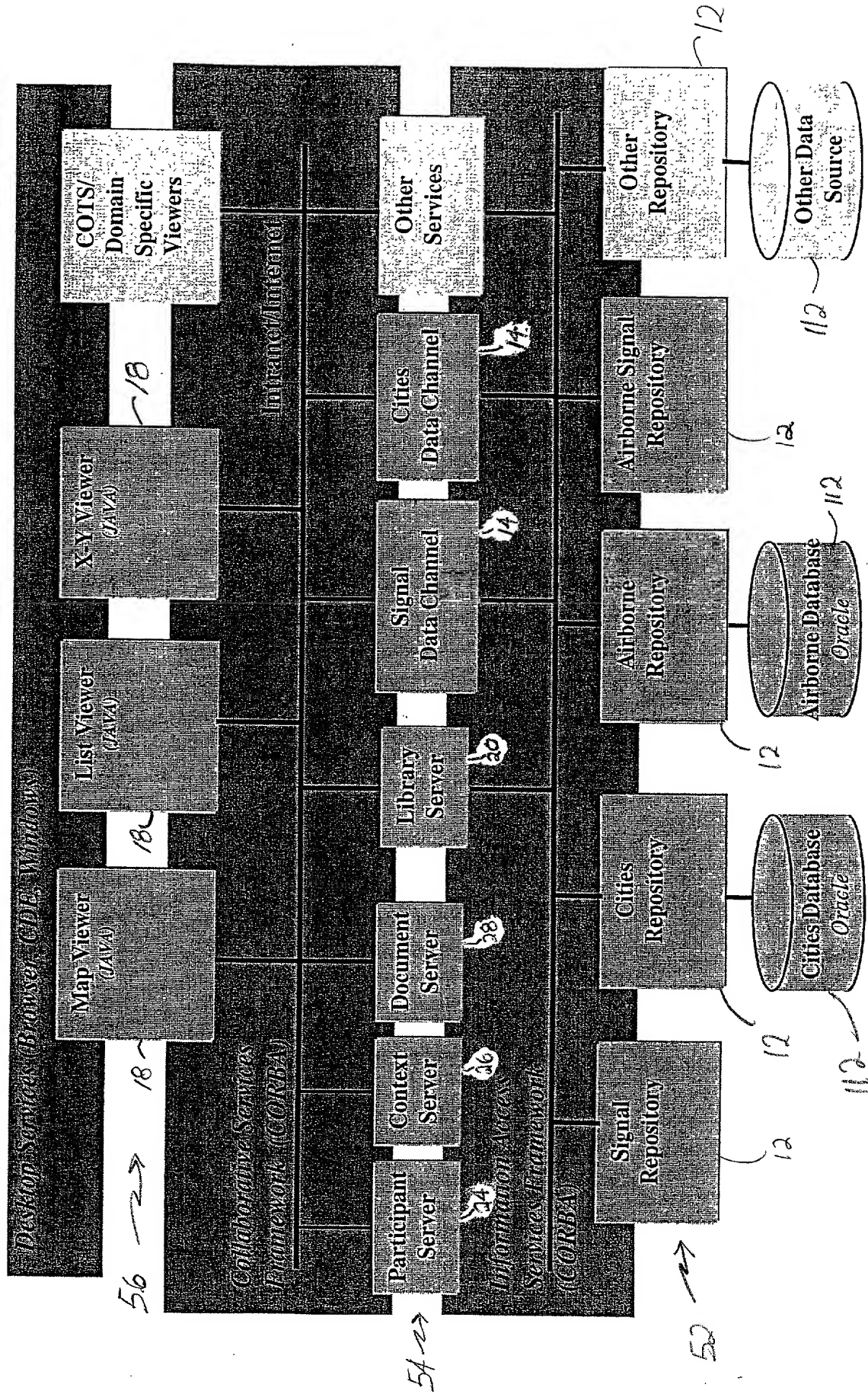
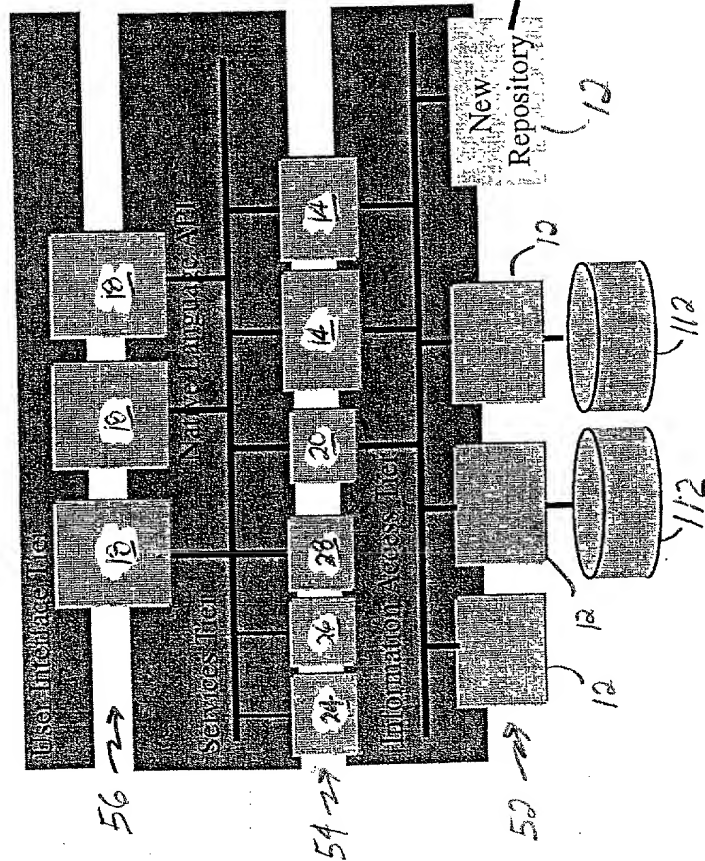


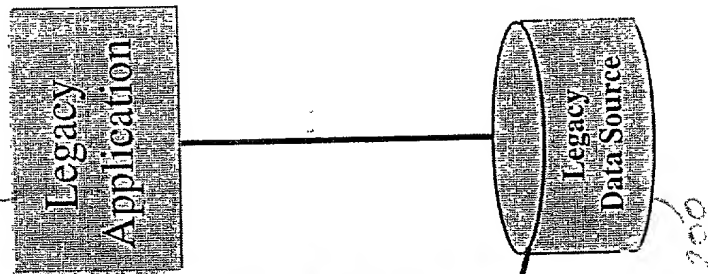
Fig. 10

Integration with legacy systems

Minimum Level Integration



- Provide access to legacy data source through a new repository
- No legacy software changes required
- New data source is available for collaborative processing
- Provides new options for extending system capabilities
- Low/No Risk implementation



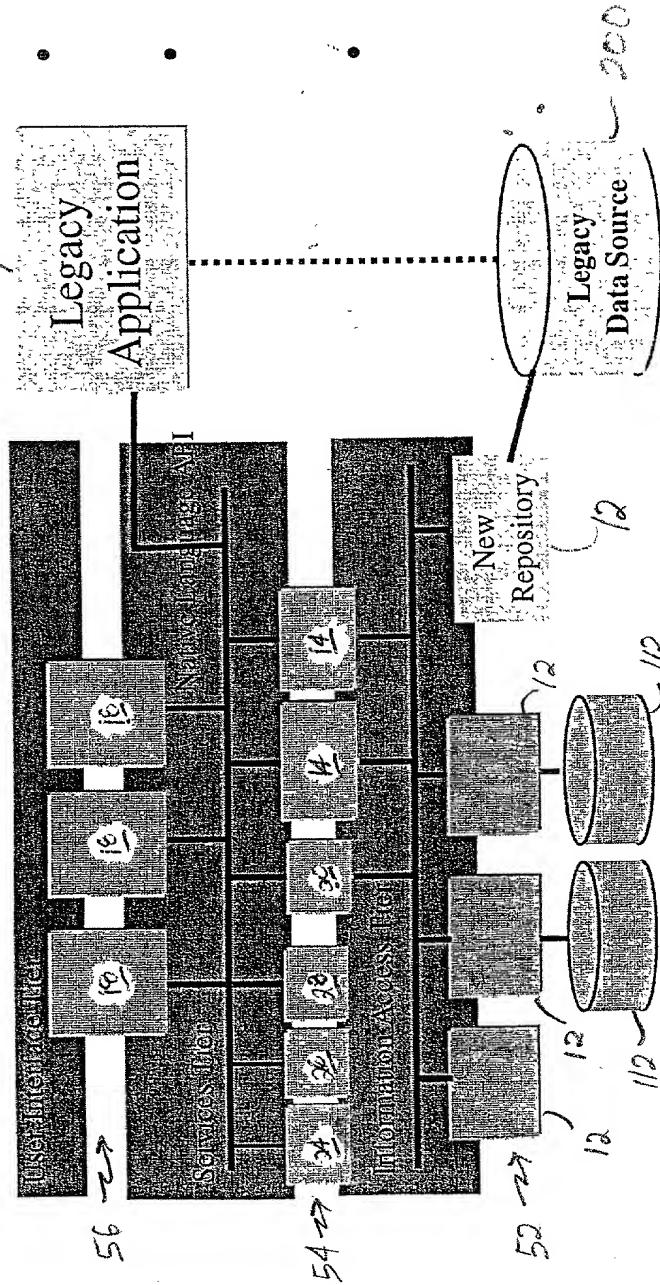
SYSTEM Infrastructure Legacy System

Fig 11

Integration with legacy systems

Mid-Level Integration

- Access data through Tsunami infrastructure
- Legacy viewers are now interact collaboratively
- Still maintain the option to interact directly with the data source
- Provides additional options for extending system capabilities

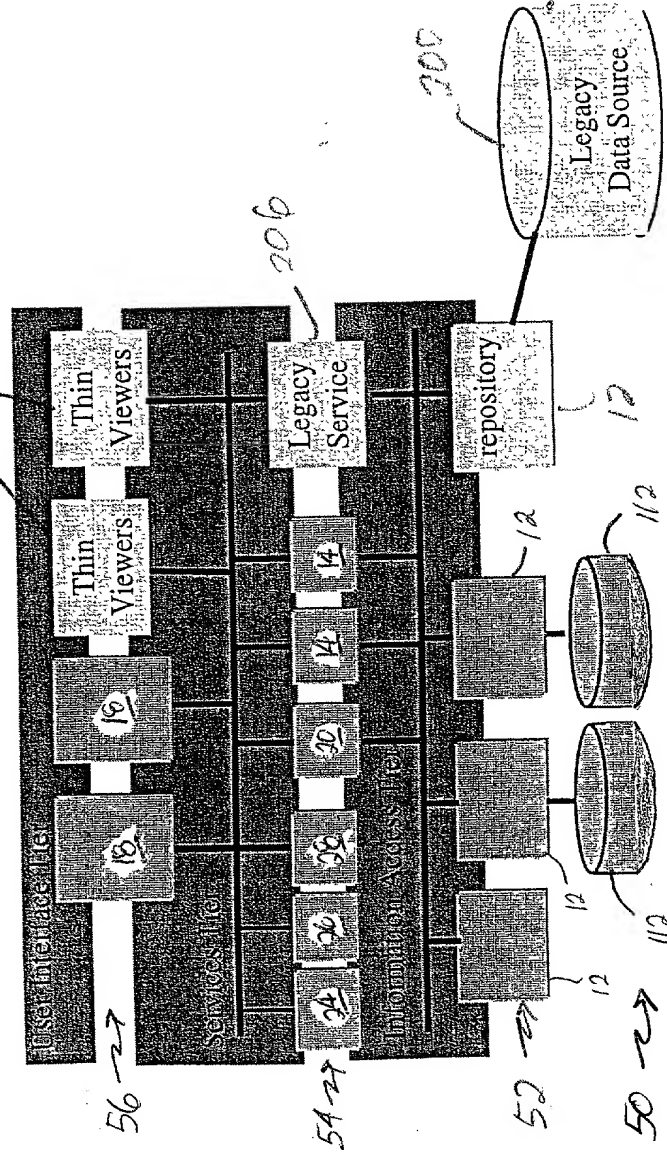


SYSTEM Infrastructure Legacy System

Integration with legacy systems

Full Integration

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- Rewrite viewers in Java making them web-enabled and machine independent
- Legacy processing becomes a system component available for enterprise usage
- Lowers maintenance cost
- Duplicate functionality removed across the enterprise
- Each enhancement is available to the entire enterprise

SYSTEM Infrastructure Legacy System

Fig. 13

Importance of Data-Centric Collaboration Framework

- Framework is applicable to most domains
- Small tools extend overall capability
 - Build domain or analyst specific tools--not systems
 - Adding single collaborative capabilities results in exponential growth of overall system capability
- Collaboration integral to framework
 - Instead of pasting images onto a whiteboard, collaborate on the tool itself using whiteboarding layer
 - No special logic needed in tools to support collaboration
- Supports legacy applications
 - Data is shared and not replicated, so changes to the data by legacy tools propagate to collaborative tools.

Collaboration Application Management

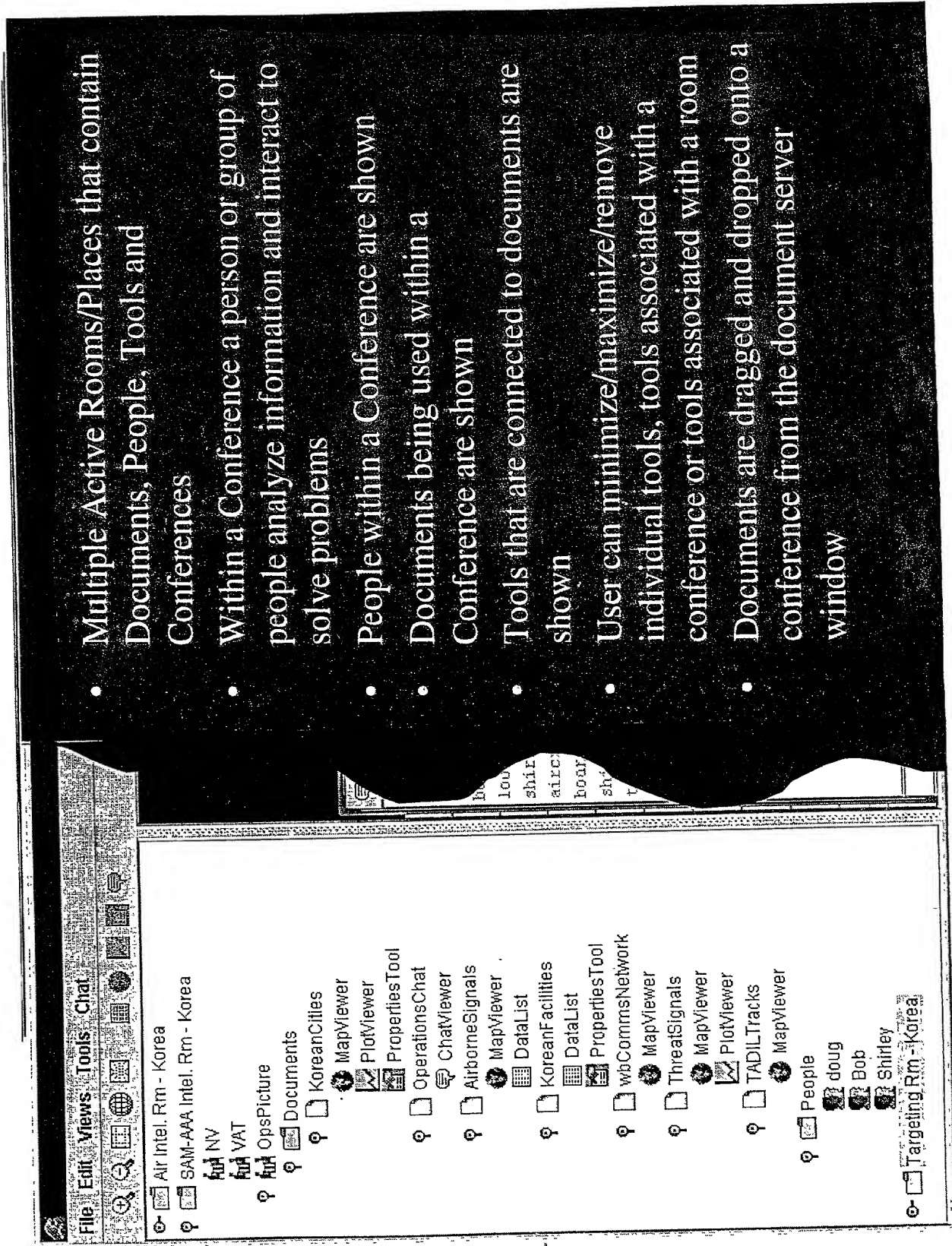
The screenshot displays a complex software interface with multiple panes. At the top, a menu bar includes 'File', 'Edit', 'Views', 'Tools', and 'Edit'. Below the menu, a toolbar contains various icons for file operations and viewing. The main workspace is divided into several sections:

- Participants List (Left):** A list of users and roles, including 'SAM-AAA Intel Rm - Korea', 'Air NV', 'Air VAT', 'OpsPicture', 'Documents', 'ThreatSignals', 'ArborneSignals', 'TADIL Tracks', 'Korean Facilities', 'Korean Cities', 'wbCommsNetwork', 'OperationsChat', 'People', 'doug', 'Bob', 'Shirley', 'Air Intel Rm - Korea', and 'Targeting Rm - Korea'.
- OpsPicture - Airborne Signals - DataList (Top Left):** A table with columns: Signal Mod., Carrier Freq., Sequence, Carrier Freq., Fundame. The data rows show various signal parameters.
- OpsPicture - TADIL Tracks - DataList (Top Right):** A table with columns: TRACKNO., TRACKDES., LATITUDE, LONGITUDE, ALTITUDE. The data rows show track information.
- OpsPicture - ThreatSignals - Plot (Bottom Left):** A graphical plot showing signal tracks over time, with labels for 'Sig-64', 'Sig-78', 'Sig-79', and 'Sig-63'.
- OpsPicture - ThreatSignals - Plot (Bottom Right):** A graphical plot showing signal tracks over time, with labels for 'Sig-64', 'Sig-78', 'Sig-79', and 'Sig-63'.
- OpsPicture - OperationsChat - ChatViewer (Bottom Center):** A chat window displaying messages from 'shirley' and 'bob'.

Below the screenshot, a list of bullet points describes the application's features:

- Runs in a Web Browser or as a separate Unix or NT Application.
- Provides ease of access to room and conference information
- Allows multiple saved workspaces consisting of conferences and tools.
- Allows drag and drop of documents to viewers
- Allows easy navigation between conferences and rooms.

Collaborative Application Management



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Dynamic Repository Query & Document Management

- Dynamically learns about repository
- Gets attribute meta-data from repository
- Creates agent representing standing query
- Results become a document which may be used for collaboration

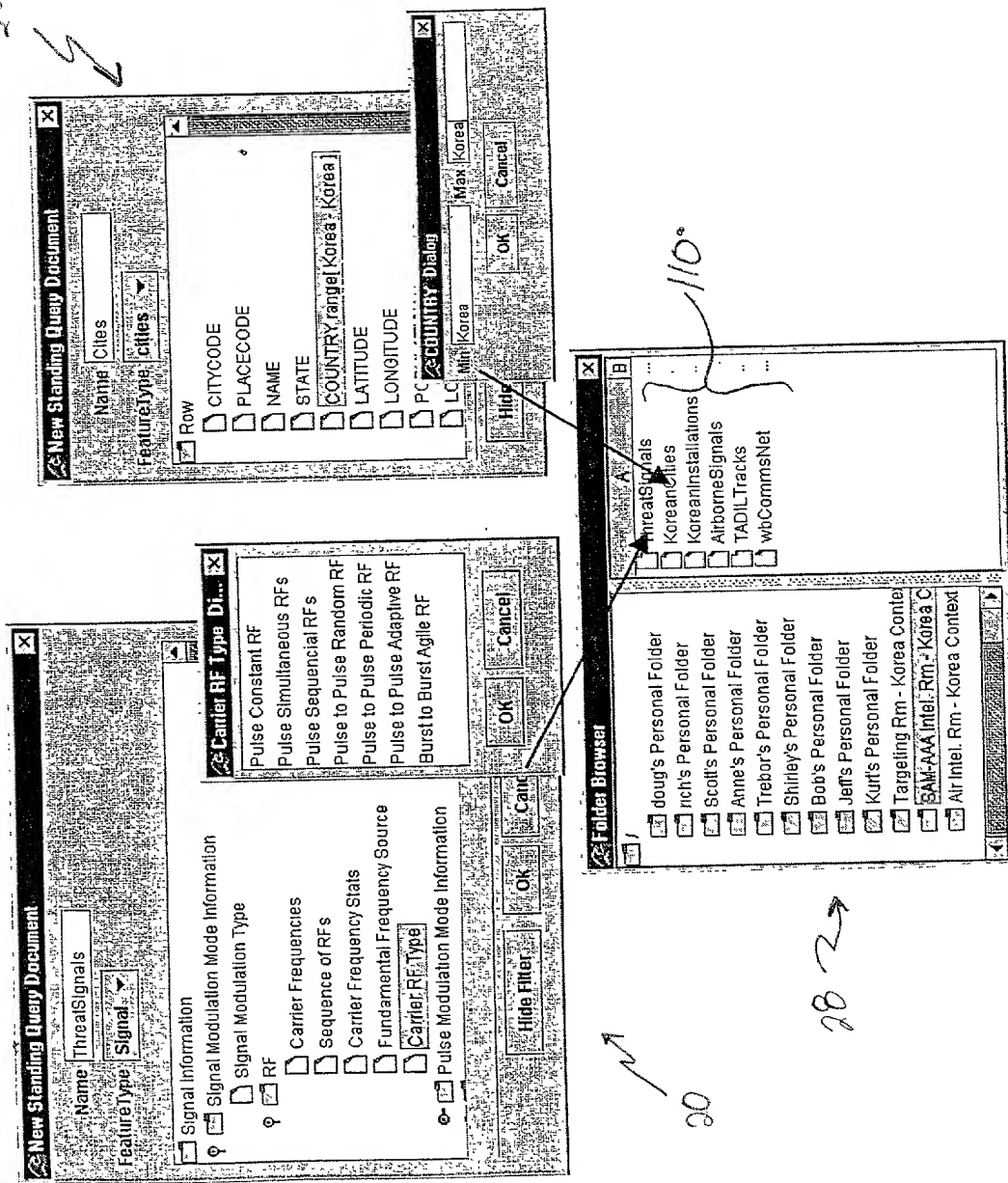


Fig. 17

Map And White-Board

Interaction

- The BBN Open Map Viewer was selected since it supported layering and a standards-based interface. No license fee is required. It is an Open Source component.
- A Mercator projection is shown with items colored via the data model
- A configurable pop-up menu can be seen
- Integration with commercial and legacy map products is based on OpenGIS standard APIs.

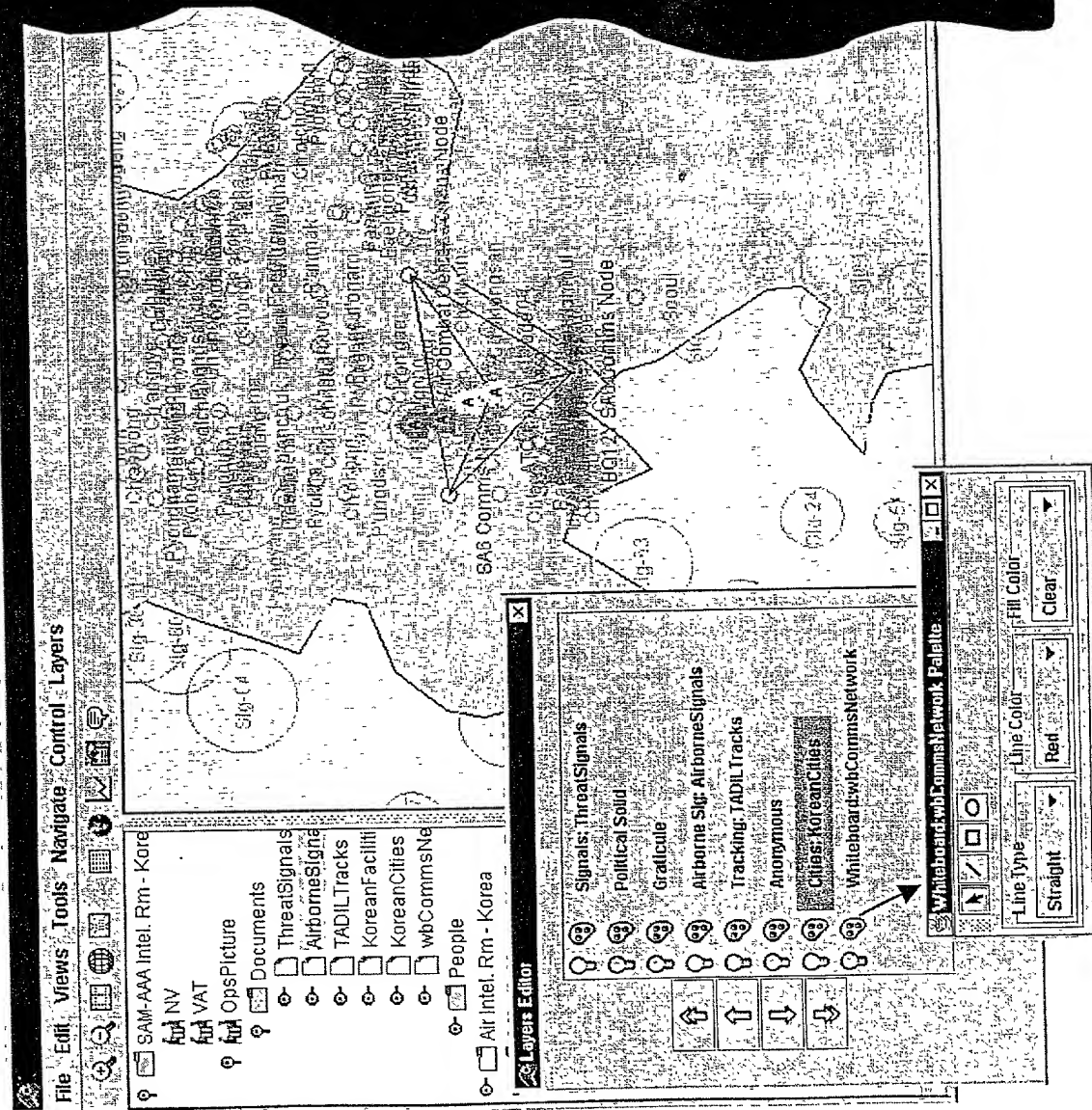


Fig. 18

Extended Properties Editor

- Dynamically learns information schema from repository
- Attaches extended properties to data in the data channel
- Applied rules run as agents within the channel
- Extended Properties
 - Color
 - Highlight
 - Visibility
 - Label
 - Symbol
 -

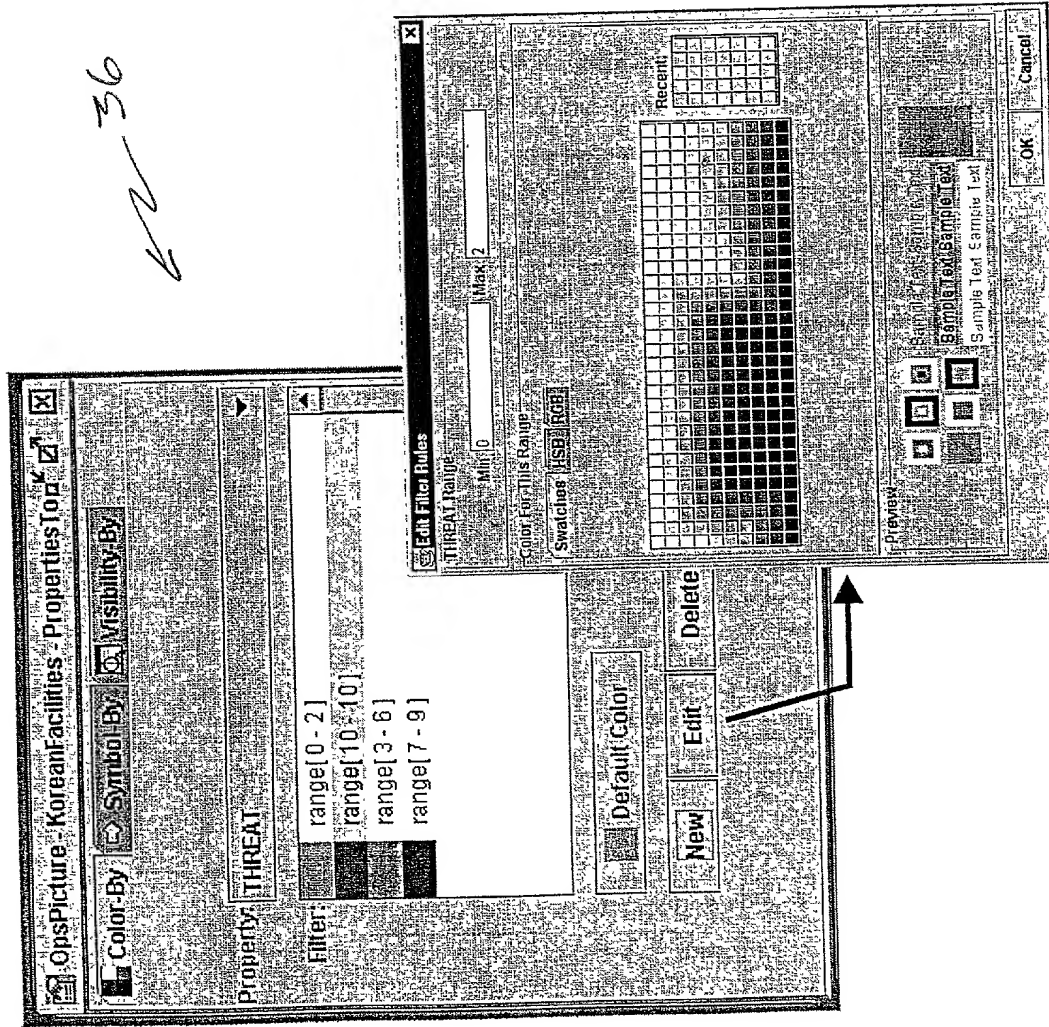


Fig. 19

X-Y Plotter

- Select X and Y Attributes From List provided by Repository
- Re-order displays
- Zoom/Pan in any display independently or
- independently

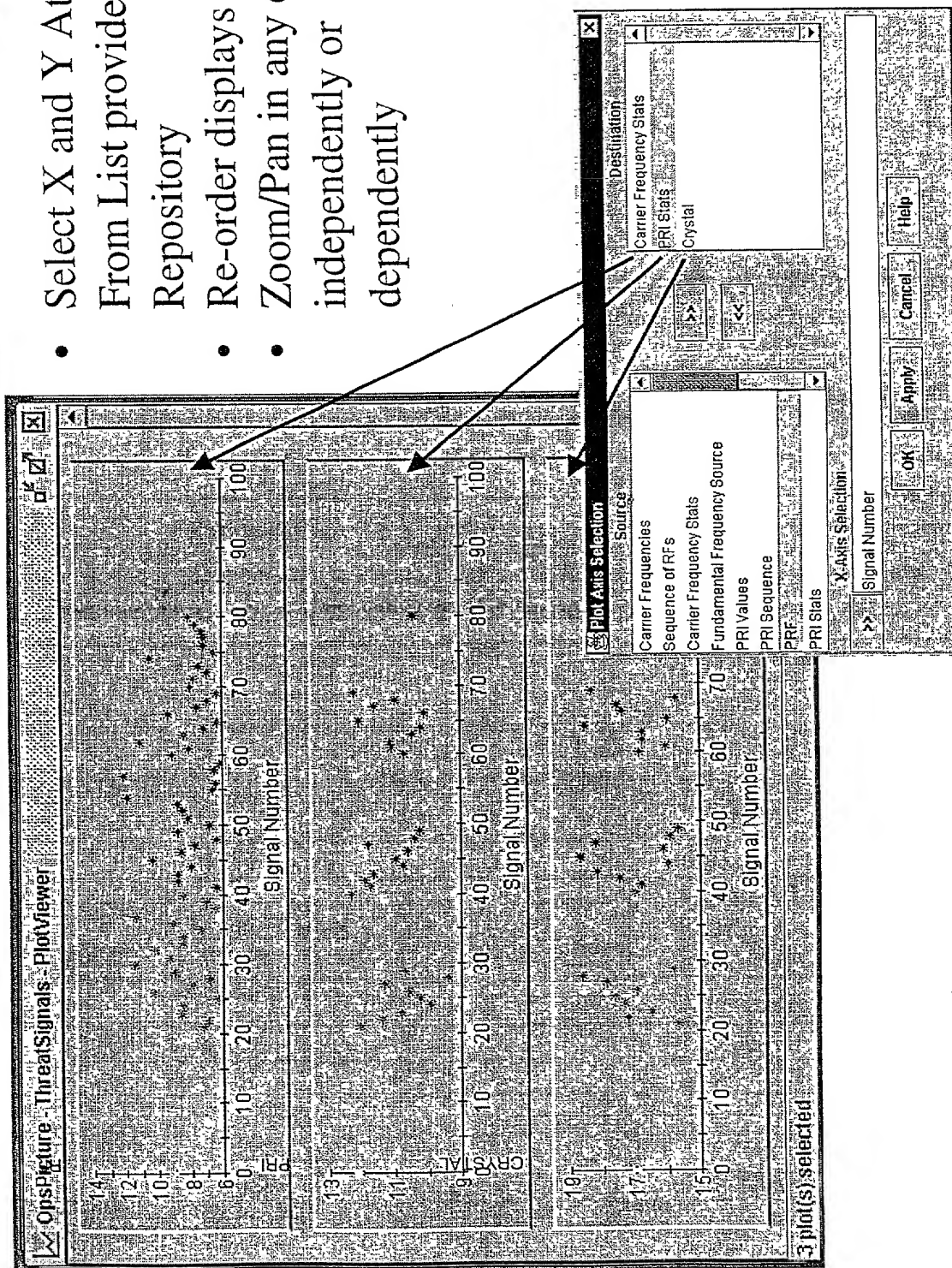


Fig. 20

List Viewer

- Sorting
- Row Selection
- Row Coloring
- Row Hiding
- Choose Attributes to View

OpsPicture KoreanFacilities - DataList

SITECODE	NAME	COUNTRY	LATITUDE	LONGITUDE	THREAT
KN000001	Chonju	KN	39.233333	127.05	3
KN000002	Ghilla	KN	39.488887	127.05	6
KN000003	Paibong	KN	39.418887	127.066667	4
KN000004	Changmok	KN	39.433333	127.066667	5
KN000005	Pyongsari	KN	39.233333	127.1	0
KN000006	Pyongsari	KN	39.233333	127.1	0
KN000007	Pyongsari	KN	39.233333	127.1	0
KN000008	Pyongsari	KN	39.233333	127.1	0
KN000009	Pyongsari	KN	39.233333	127.1	0
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KN000016	Pyongsari	KN	39.233333	127.1	0
KN000017	Pyongsari	KN	39.233333	127.1	0
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KN000019	Pyongsari	KN	39.233333	127.1	0
KN000020	Pyongsari	KN	39.233333	127.1	0
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KN000099	Pyongsari	KN	39.233333	127.1	0
KN000100	Pyongsari	KN	39.233333	127.1	0

18

Chat Tool

- Chat supports multi-user conversations from multiple conferences in multiple contexts
- People connect to a document and communicate
- People in the same conference see the same visualization properties like color and visibility of participants inputs
- Conversations are persistent over time

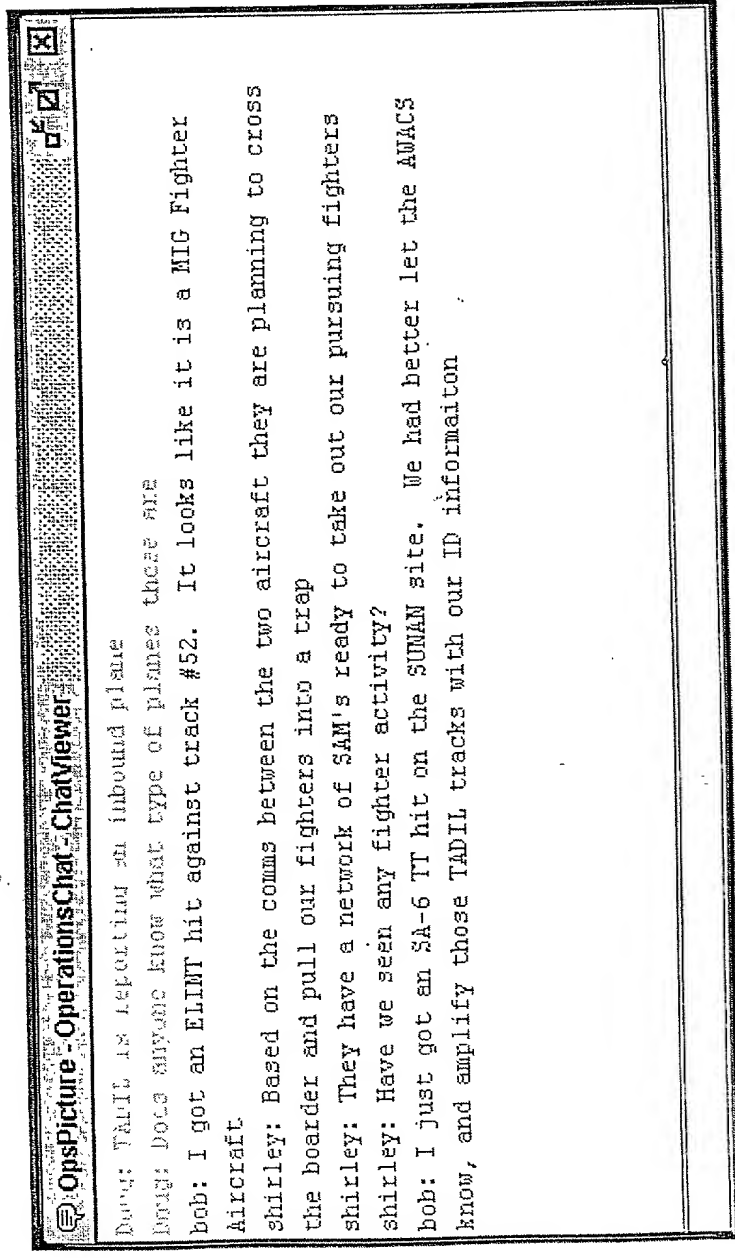


Fig. 22

Performance Metrics

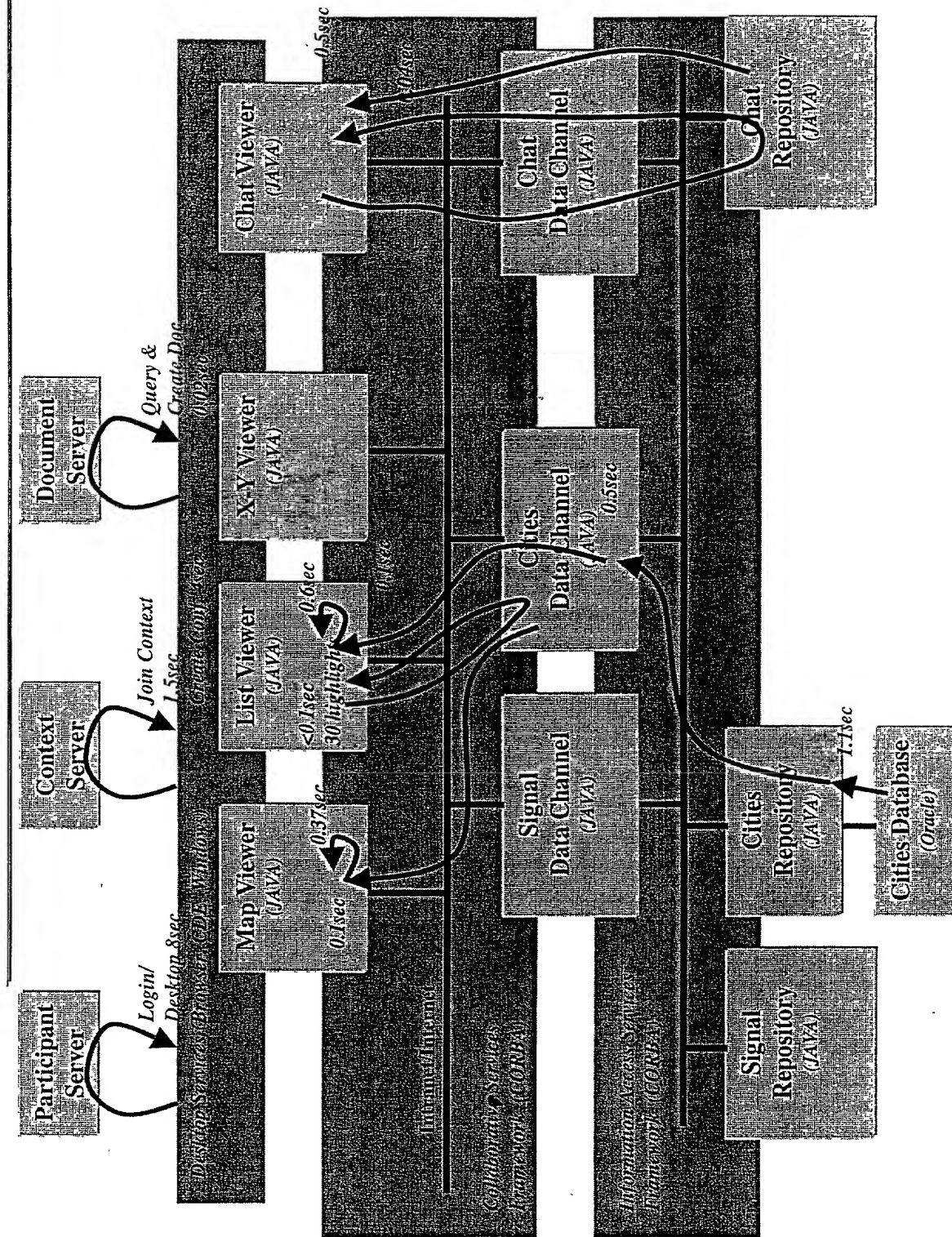
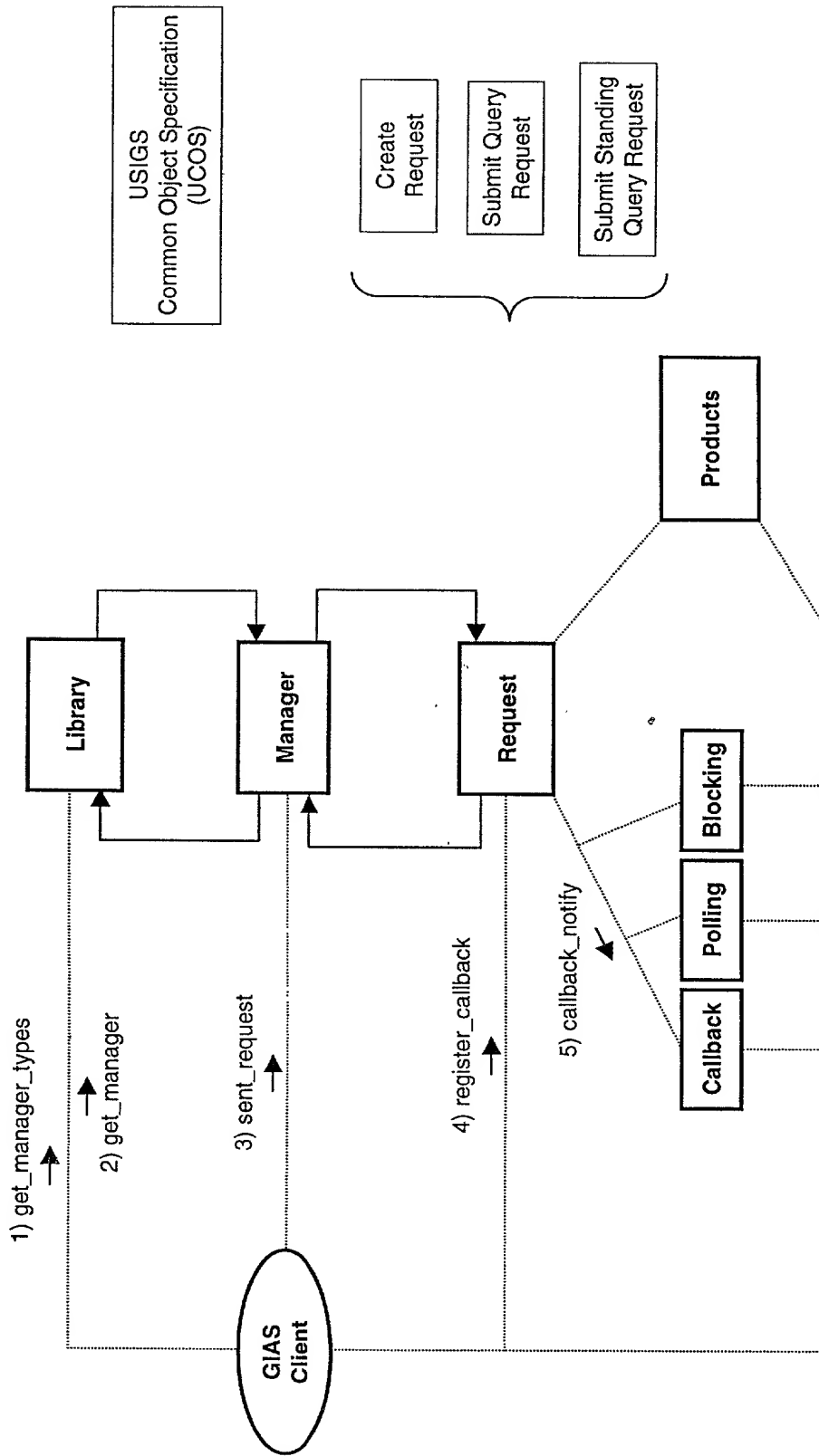


Fig. 23

USIGS - Geospatial and Imagery Access Services Specification



- Dynamic discovery of information sources
- Dynamic discovery of access techniques
- Synchronous, Asynchronous, Polling Access mechanisms
- Clients autonomous request executing within the data environment
- All Interfaces and Structures represented within IDL (UCOS - DAG)

Fig. 24

Variable	Mean	SD	Min	Max	Skewness	Kurtosis	Normality
Age	35.2	12.5	18	65	0.15	3.2	0.98
Gender	1.2	0.4	1	2	0.05	3.0	0.99
Education	12.5	2.1	9	16	0.25	3.5	0.97
Income	15000	8000	5000	35000	0.35	3.8	0.96
Health	2.5	0.8	1	4	0.10	3.1	0.99
Stress	3.2	1.1	1	5	0.20	3.4	0.98
Life Satisfaction	4.1	0.9	2	5	0.18	3.3	0.97
Work Satisfaction	3.8	1.0	2	5	0.22	3.6	0.96
Family Satisfaction	4.3	0.8	3	5	0.12	3.2	0.99
Community Satisfaction	3.9	1.1	2	5	0.25	3.7	0.95
Overall Satisfaction	4.0	0.9	2	5	0.15	3.3	0.98



Library Virtual Access

Requesting Information

- Client knows only about Library
- Client learns about Feature Types through Feature Type Mgr
- Client submits query through the Standing Query Mgr
- Repository and Feature Collection adapt to Database Particulars

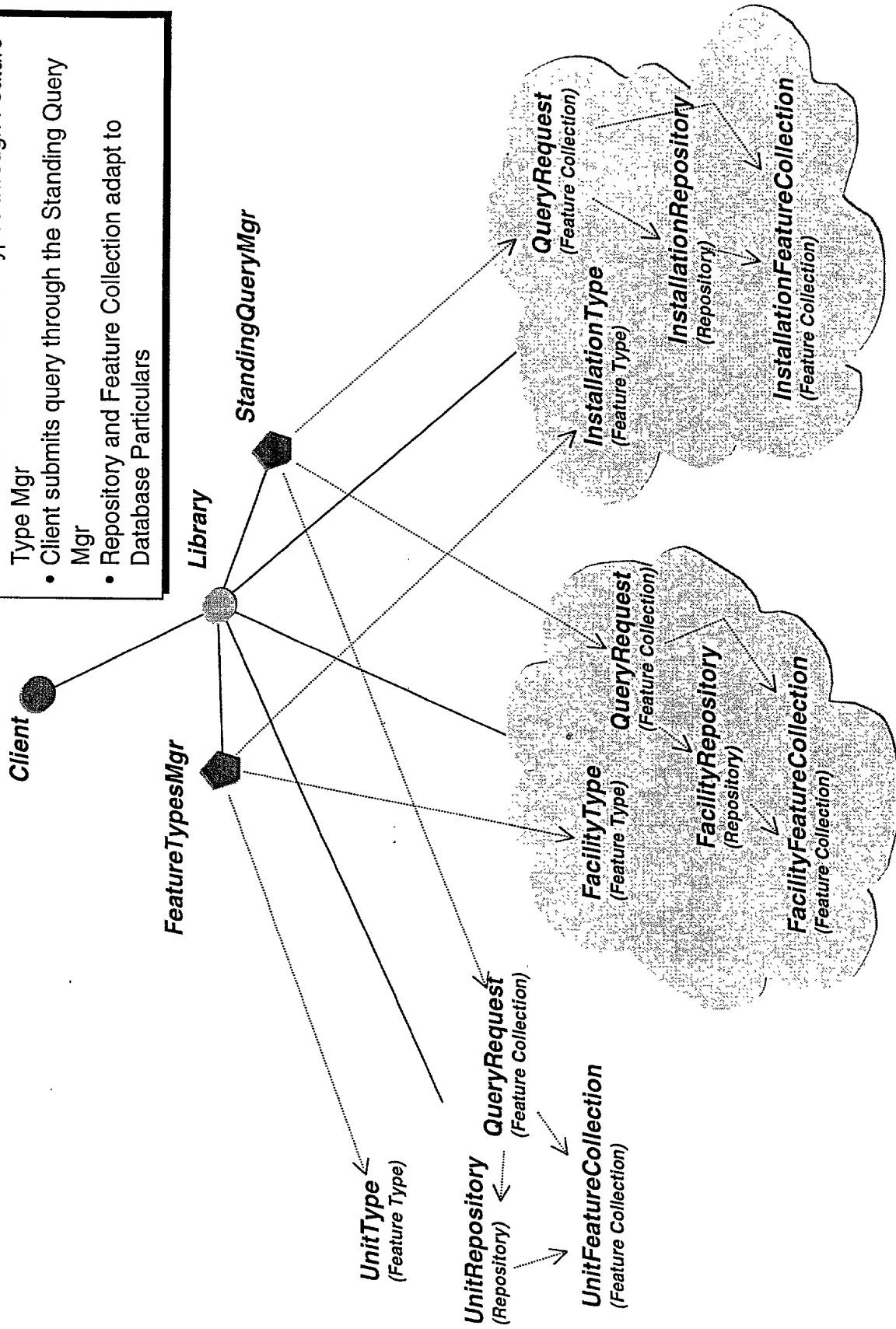
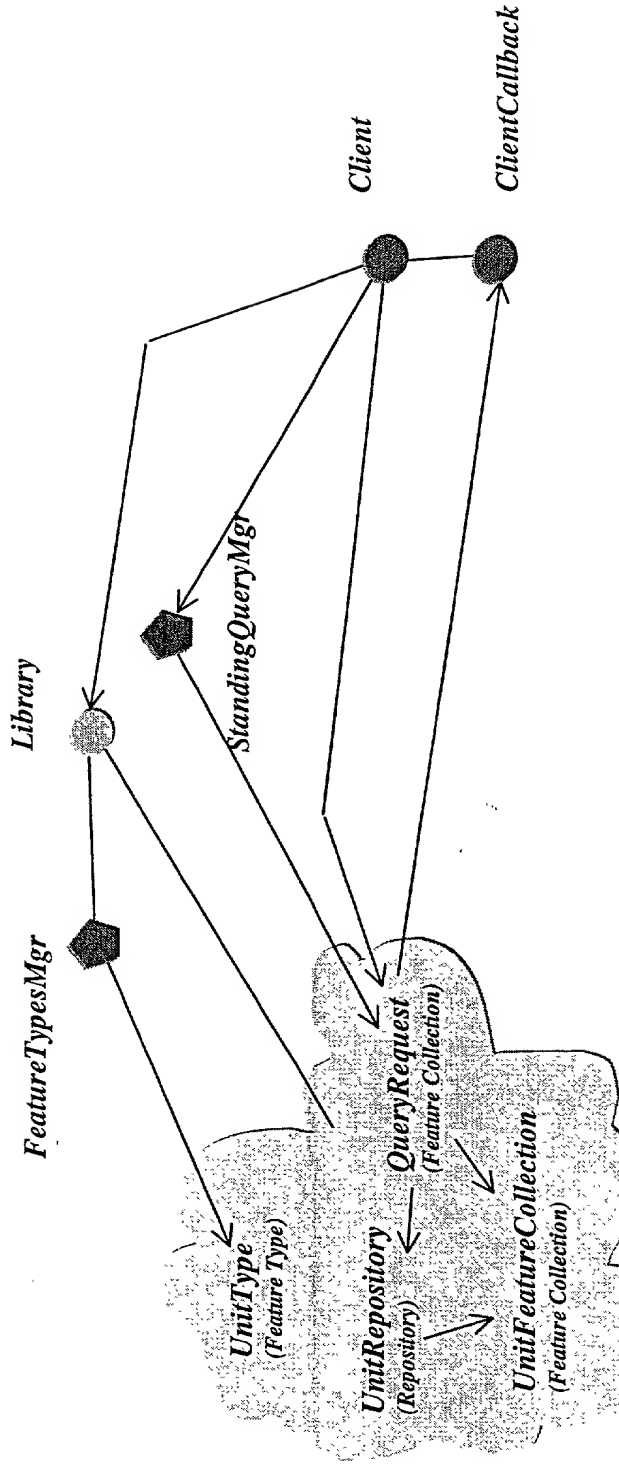


Fig. 26

Library Virtual Access

Accessing Current Information



- Client Learns about Standing Query Mgr through Library
- Query Manager returns a reference to a Request Object for each client query method invocation
- Client interacts with Request for Query Control and Status
- Request supports Synchronous, Polling, and A-Synchronous Client interfaces. ClientCallback is used for A-Synchronous feedback on query state

Fig. 27

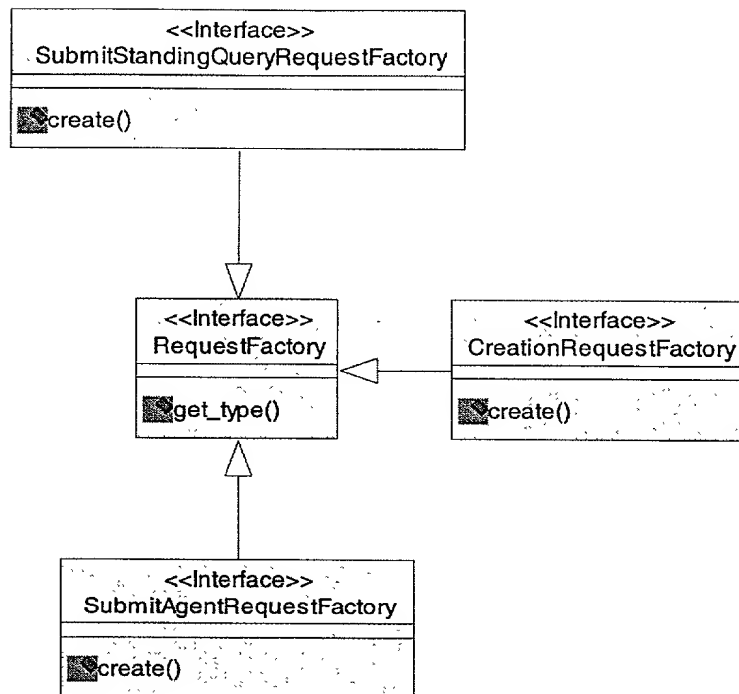


Fig. 28

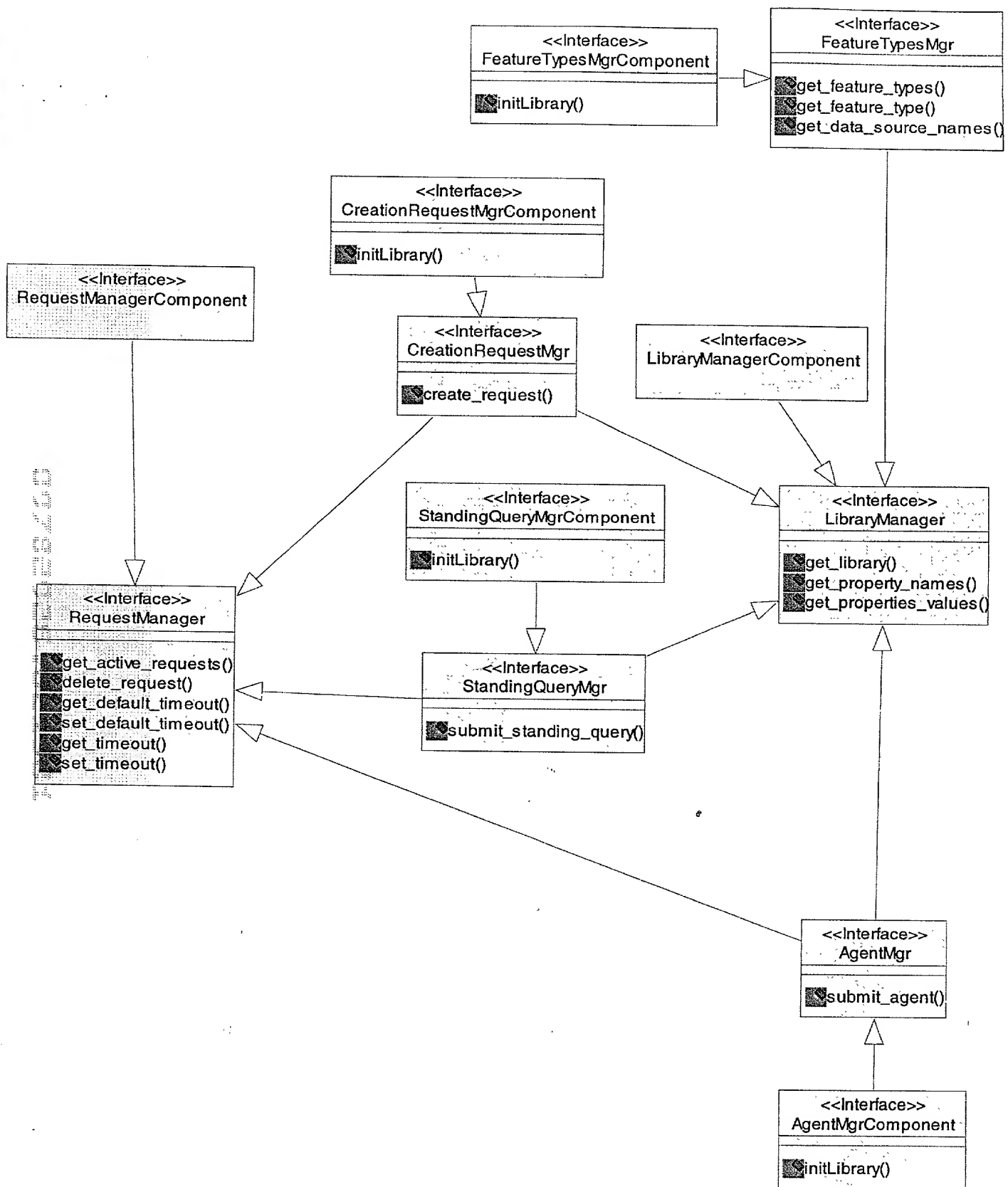


Fig. 29

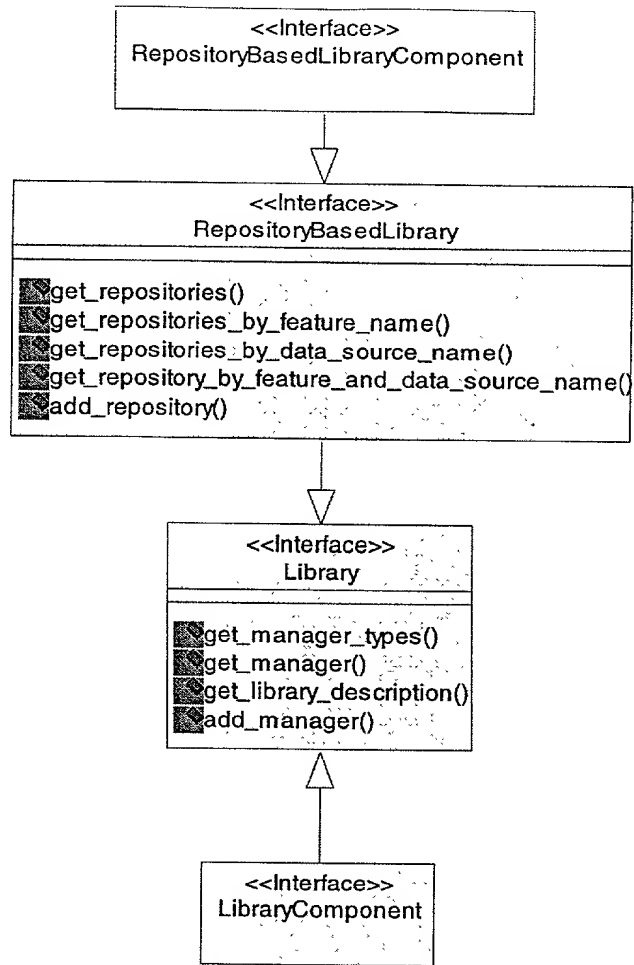


Fig. 30

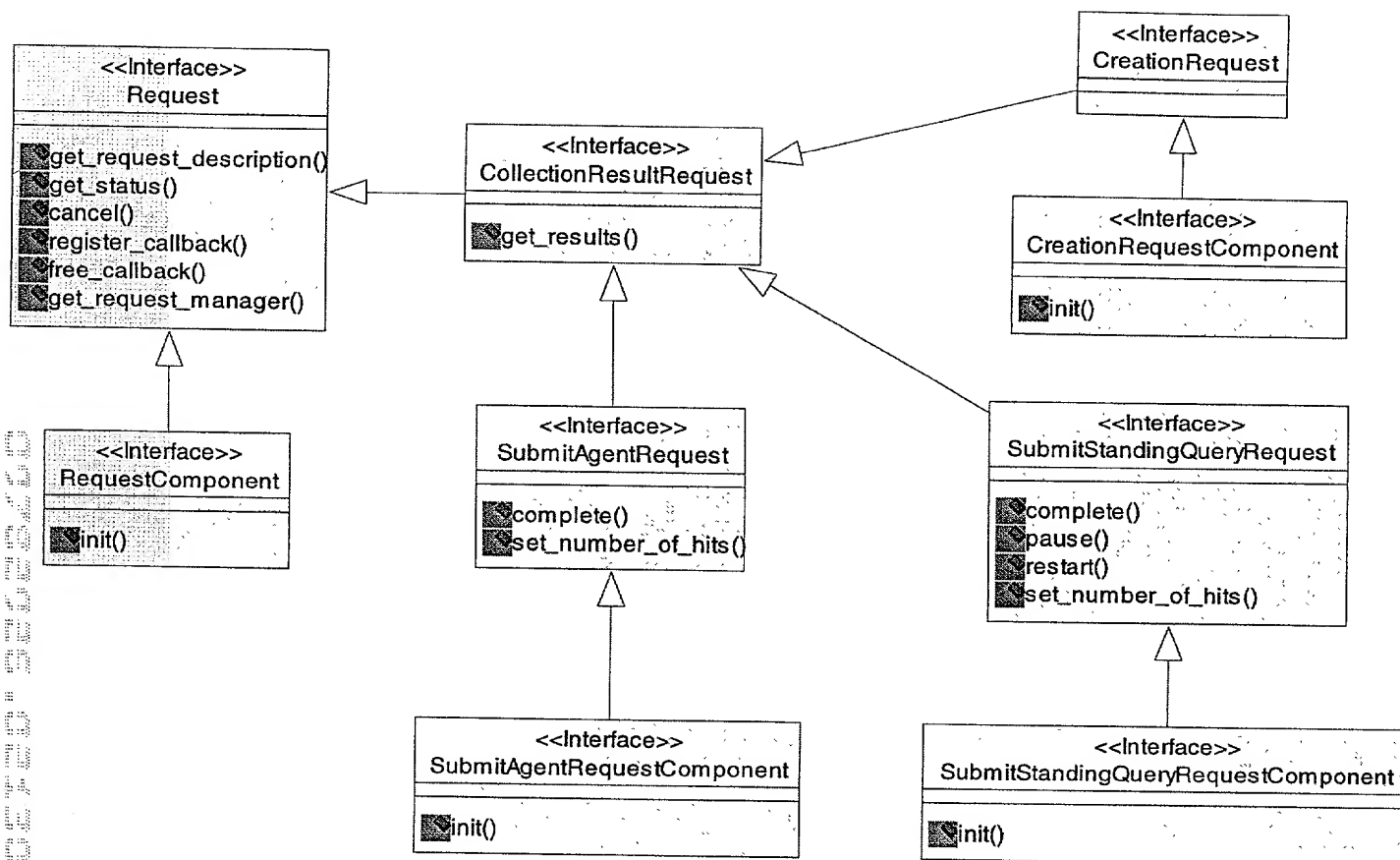


Fig. 31

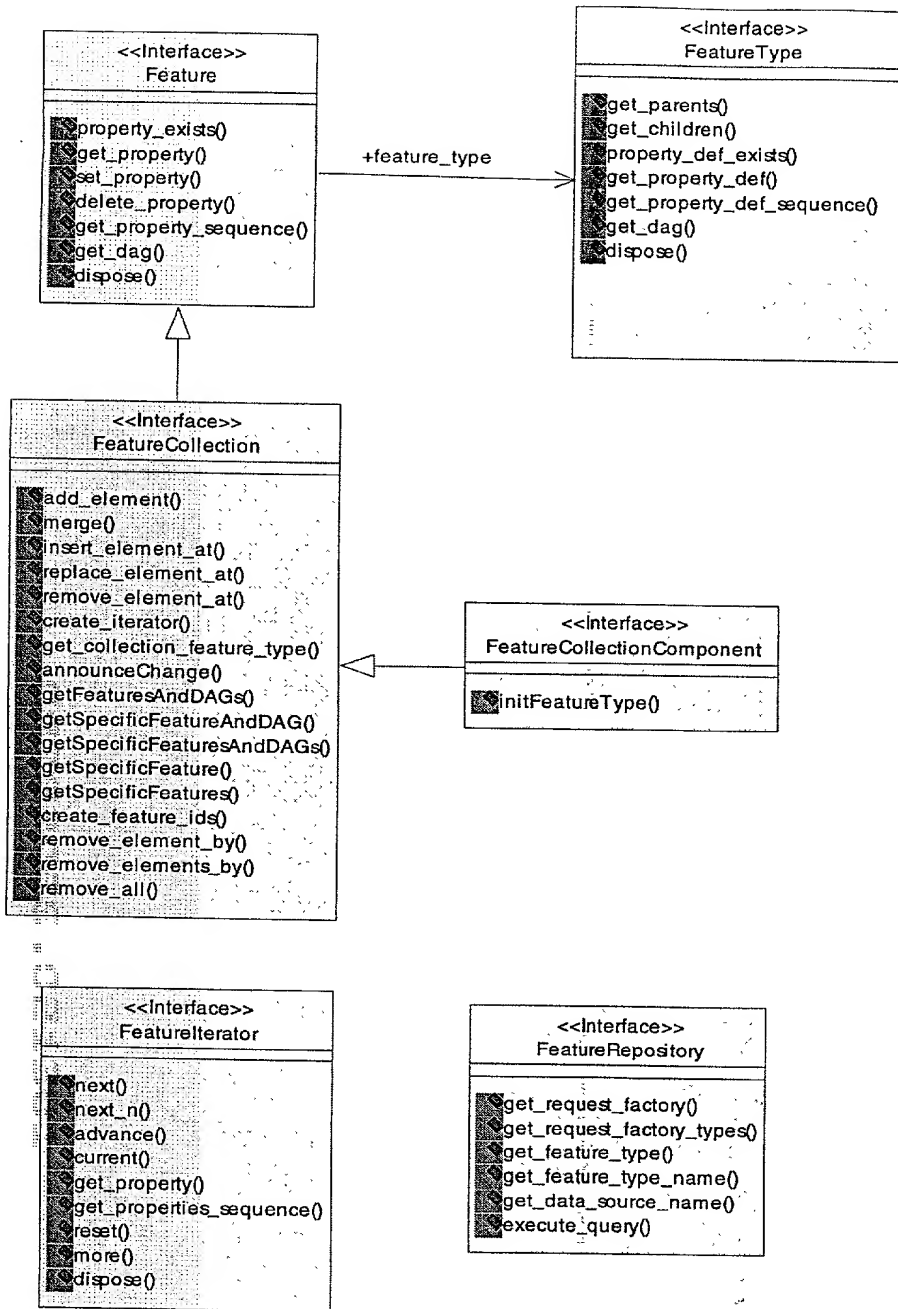


Fig. 32

[illegible]

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4

Versioning Data Changes in the Data Channel

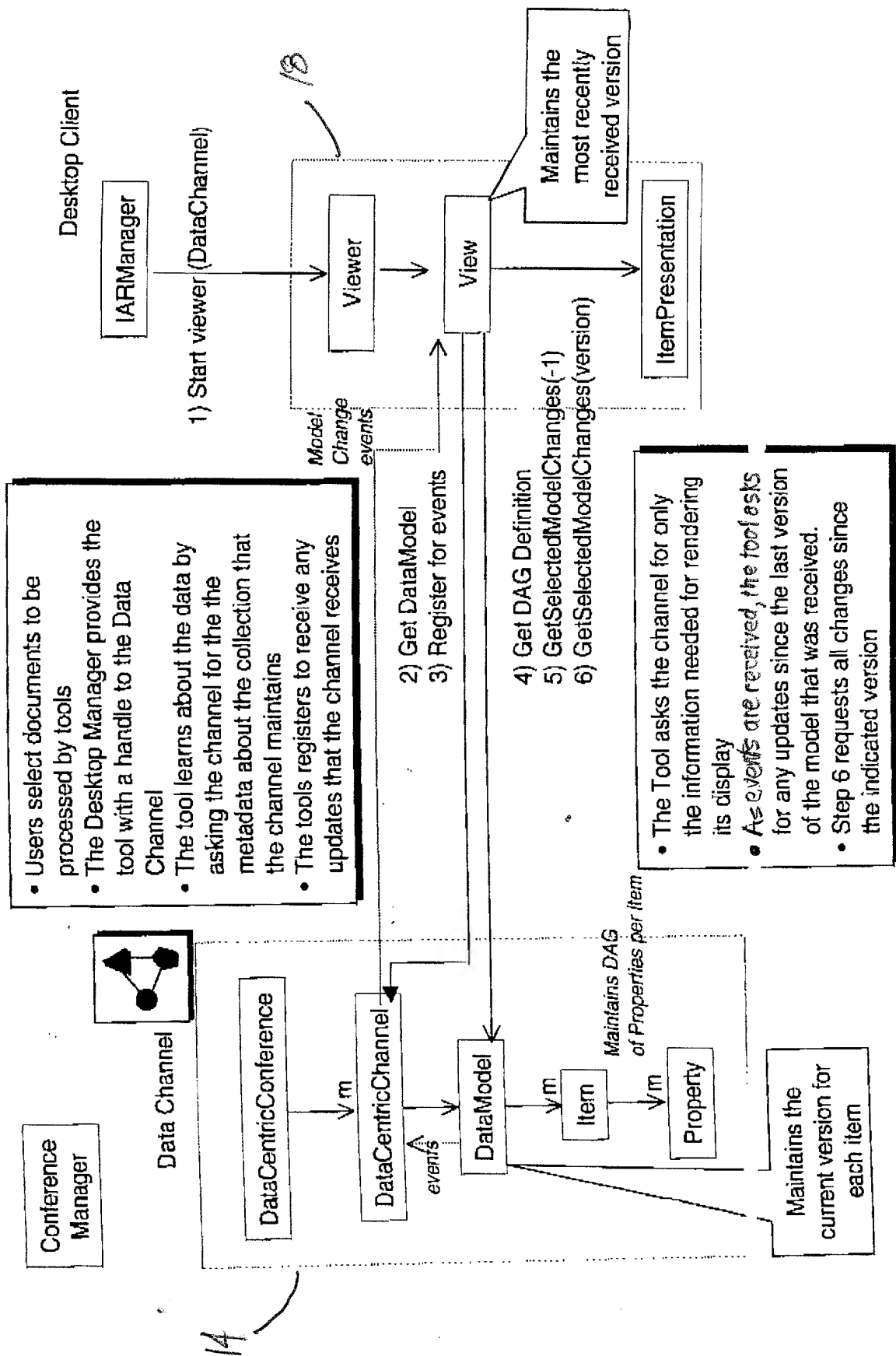


Fig. 34

OpenGLS Simple Features Specification

Understanding a Feature Collection

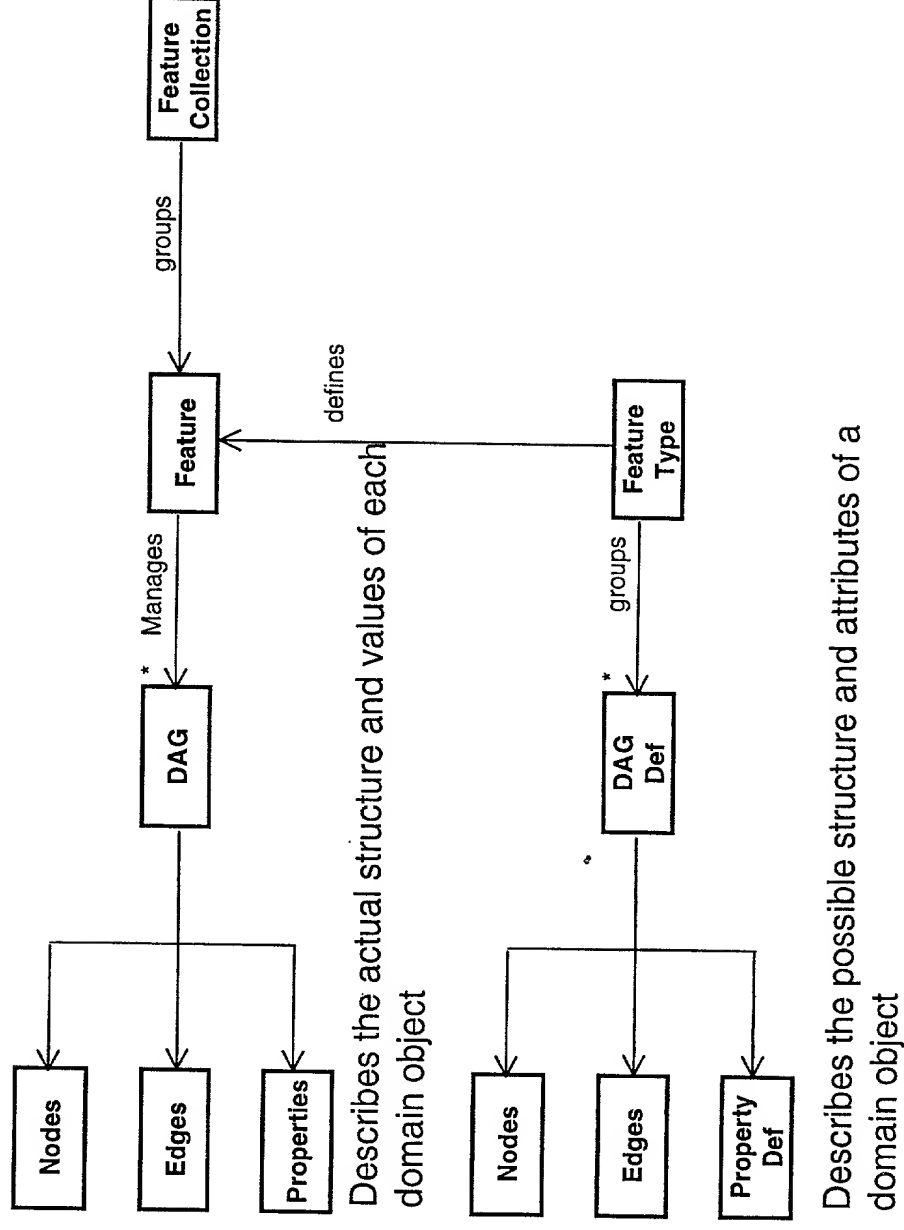


Fig. 35

Directed A-Cyclic Graph (DAG)

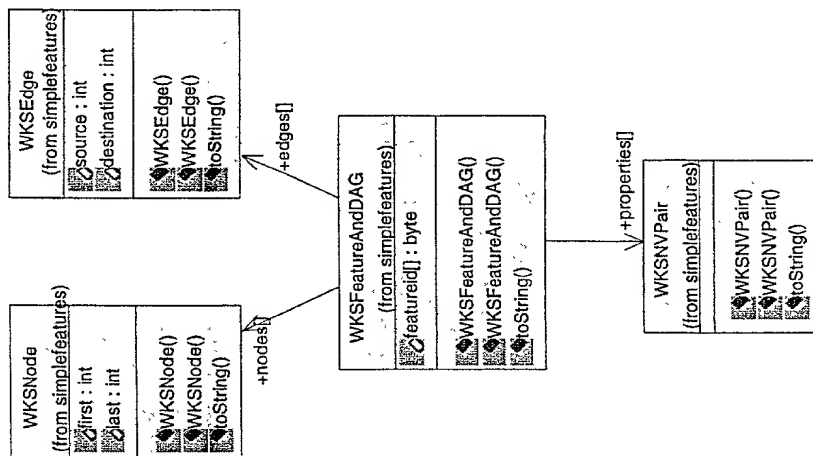
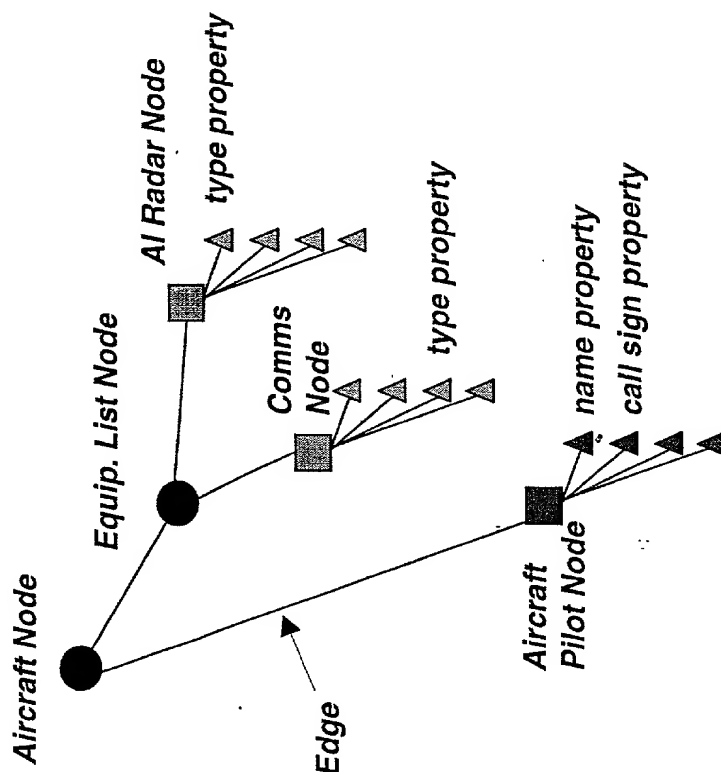


Fig. 36

Directed A-Cyclic Graph (DAG)

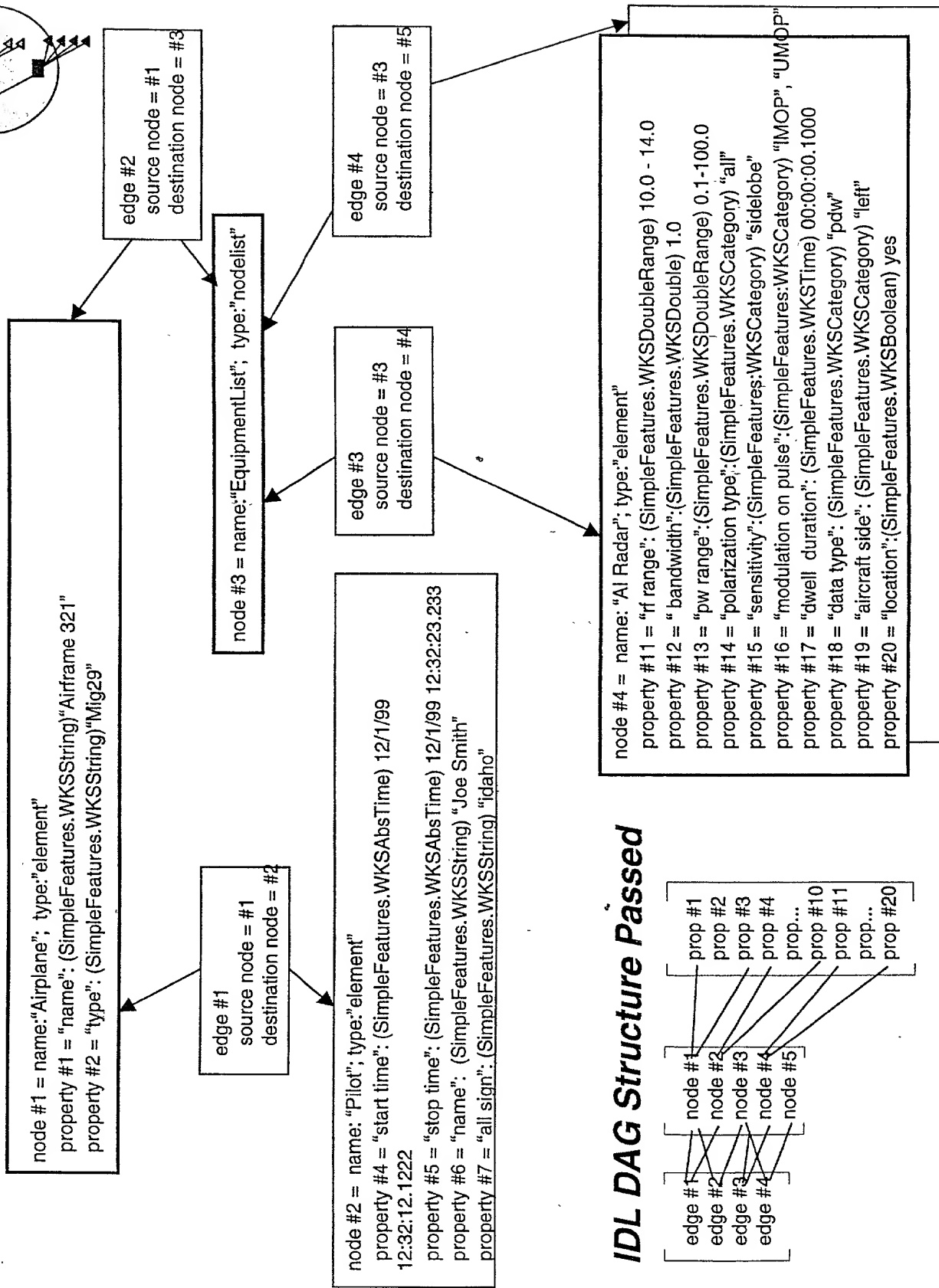
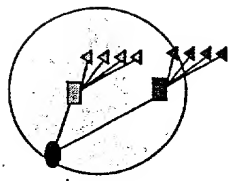


Fig. 37